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Examination	Requested
Title of Invention	A down-up type eletrospinning aparatus



Abstract

The invention relates to the ultrafine fiber for manufacture down-up type eletrospinning aparatus in which it goes to the nano level to be thick. The nozzle (4a) exit installed at (i) nozzle block (4) as to the electrospinning apparatus, consisting of the voltage generating device (6) for having voltage to the collector (5), accumulating fibers radiated from the spinning dope main tank (1), the measuring pumper (2), the nozzle block (4), to the nozzle block the nozzle block (4) and collector (5) as to the electrospinning apparatus of the present invention, are formed with the upper direction. (ii) collector (5) is positioned on the top of the nozzle block. And it characterizes that the spinning dope drop apparatus (3) is installed between (iii) spinning dope main tank (1) and nozzle block (4). It maximizes the fiber-forming effect in electrospinning, the invention can select for nanofiber and their non-woven with mass production. And the phenomenon (Droplet) in which the spinning solution is unable to be formed with fiber and falling down to droplet-wise is effectively prevented and nanofiber and non-woven of the high quality can be produced.



Representative Drawing(s)

Fig. 2



Keyword(s)

The electrospinning, apparatus, non-woven, nano, bottom-up radiation, spinning dope, voltage, drop let.



Description

■ Brief Explanation of the Drawing(s)

Figure 1 is a schematic diagram of the invention electrospinning apparatus.

Figure 2 is a schematic diagram of the nozzle block (4).

Figs. 3 and 5 are the schematic diagram showing the side of the nozzle (4a).

Figs. 4 and 6 are the plane example diagram of the nozzle (4a).

Figure 7 is a Electron micrograph of the conventional nano fiber non-woven fabric.

Figure 8 is a Electron micrograph of the polyester nano fiber non-woven fabric manufactured with the invention apparatus.

Figure 9 is a Electron micrograph of the silica / polyvinyl alcohol nano fiber non-woven fabric manufactured with the invention apparatus.

Figure 8 is a nano particle Electron micrograph of the polyglycolide manufactured with the invention apparatus.

※ The code description about the among drawing main part.

1: spinning dope main tank 2: measuring pumper 3: the spinning dope dropping apparatus.

4: nozzle block 5: collector (conveyor belt) 6: voltage generating device.

4a: nozzle 4b: the nozzle external diameter hole 4c: insulator plate.

4d: spinning solution temporary service pipe 4e: nozzle plate 4f: spinning solution main supply pipe.

4g: heater 4h: electric conductor board 6: nozzle outlet angle.

L: nozzle length DI: nozzle bore Do: nozzle external diameter.

■ Details of the Invention

■ Purpose of the invention

• The Technical Field to which the invention belongs and the Prior Art in that Field

The invention relates to the electrospinning apparatus doing the fiber (hereinafter it is called " nanofiber ") which is the nano level to be thick with mass production.

Product including the non-woven, the Membrane Journal, blade etc. consisting of nanofiber is widely utilized as the daily supplies, agricultural, clothes dragon, the industrial etc. Specifically, it is used in the various with the medical material of the artificial leather, imitation suede, sanitary napkin, garment, diaper, packing material, the material for the general merchandise, all kinds of the filter materials, gene delivery, the bulletproof vest, including, the material for the national defense etc. field.

The manufacturing method of the non-woven using this and conventional electrospinning apparatus in US4,044,404 A moat are as follows. The conventional electrospinning apparatus is comprised of the collector (5) accumulating the spinning dope main tank (1), keeping the spinning dope the measuring pumper (2) for the fixed quantity supply of the spinning dope, the nozzle block (4) in which a plurality of nozzles discharging the spinning dope is arranged, and fibers which are positioned in the lower part of nozzle and are radiated and the voltage generating device (6) nurse generating voltage.

Specifically if the conventional nonwoven fabric manufacture method using the electrospinning apparatus is looked into, the spinning dope main tank (1) my spinning dope is consecutively supplied through the measuring pumper within a plurality of nozzles in which the high voltage is given with a fixed quantity.

And then, it is focused and the spinning dope supplied to nozzles the staple-fiber web is formed with the radiation as the on the collector (5) in which the voltage which is high through nozzle hangs.

And then, the staple-fiber web is embossed or it needlepunches and non-woven is manufactured.

The manufacturing method of the non-woven using this and this kind of the conventional electrospinning apparatus have the problem that the electric force effect which is given because it is consecutively supplied with the spinning dope to the nozzle in which the high voltage hangs is degraded.

More specifically, there is a problem that the electric force was unable to overcome the interfacial tension of the spinning dope since the given electric force was dispersed into the spinning dope whole in nozzle. Consequently the fiber-forming effect by the electric force was degraded and the phenomenon (it hereinafter can be said to be " drop let ") in which the spinning solution like that fell down to droplet-wise was generated and the quality of product was lowered. The mass production is difficult.

Moreover, the prior art has the problem that with mostly radiating in 1 hole level it is impossible to the mass production and it is impossible to commercialization.

An object of the present invention is to provide the electrospinning apparatus maximizing the electric force effect which is given to the nozzle block (4) in electrospinning, and making the electric force bigger than the interfacial tension of the spinning dope in other words and making the fiber-forming effect promoted, and for mass-producing nanofiber.

It effectively prevents the drop let (Droplet) phenomenon in electrospinning and the another object of the present invention tries to manufacture the nano fiber non-woven fabric of the high quality.

• The Technical Challenges of the Invention

The present invention is to provide the electrospinning apparatus which is possible for the mass production of nanofiber, and it prevents the drop let (Droplet) phenomenon and can manufacture the nano fiber non-woven

fabric of the high quality. For this, the invention suggests the down-up type electrospinning apparatus in which the nozzle block (4) is positioned in the collector (5) bottom.

■ Structure & Operation of the Invention

Nozzle (4a) exit installed at (i) nozzle block (4) as to the electrospinning apparatus, consisting of the voltage generating device (6) for having voltage to the collector (5), accumulating fibers radiated from the spinning dope main tank (1), measuring pumper (2), nozzle block (4), to the nozzle block the nozzle block (4) and collector (5) to the electrospinning apparatus of the present invention, for achieving this kind of subjects are formed with the upper direction. (ii) collector (5) is positioned on the top of the nozzle block. And it characterizes that the spinning dope drop apparatus (3) is installed between (iii) spinning dope main tank (1) and nozzle block (4).

Specifically the invention is illustrated through the drawing etc attached below.

While the nozzle consisting of the spinning dope main tank (1), the measuring pumper (2) for the spinning dope fixed quantity supply, and a plurality of pins is combined to the block type, the electrospinning apparatus of the present invention is comprised of the bottom-up nozzle block (4) discharging the spinning dope as the fibrous, the collector (5) accumulating simple fibers, and the spinning dope drop apparatus (3) positioned between the voltage generating device (6), generating the high voltage the measuring pumper (2) and nozzle block (4). The spinning dope main tank (1) as shown in Figure 1, keeps the spinning dope. The collector (5) accumulating simple fibers are positioned at the upper part of the nozzle block and are radiated.

The exit of the nozzle (4a) installed at nozzle block (4) as to the invention, is formed into the upper direction. The collector (5) is positioned on the top of the nozzle block (4) and the spinning solution is radiated to the upper direction.

It is comprised of insulator plate (4c) installed at the Nozzle plate (4e), the electric conductor board (4h), and the spinning solution main working board (4f) positioned in [vi] electric conductor board (4e) right below edge and the heater (4g) positioned in [vii] spinning solution main working board (4f) right below edge. As to insulator plate (4c) installed at the Nozzle plate (4e),, as shown in Figure 2, the nozzle block (4) [i] nozzle (4a) is arranged the nozzle external diameter hole (4b), covering [ii] nozzle (4a) the spinning solution temporary service board (4d) which is positioned in the Nozzle plate (4e) direct image shift while being connected to [iii] nozzle external diameter hole (4b), and [iv] spinning solution temporary service board (4d) direct image shift. The electric conductor board (4h) the pin is arranged and positioned in the Nozzle plate (4e) right below edge identically with [v] nozzle arrangement.

The exit of the nozzle (4a) has the phenomenon as shown in figs. 3 and 5, that the exit zone is expanded to the ovoid form more than 1. At this time, 90~175°, and the preferably to more do to 95~150° but thing steadily form the same spinning solution drop of form at the nozzle (4a) exit the angle (θ) is desirable.

In case the angle (θ) of the nozzle outlet exceeds 175°, it becomes the formation of drops in the nozzle surrounding and the surface tension increases. Consequently, it need the voltage which is higher in order to form nanofiber. And the problem that the phenomenon that the drop core region is solidified as the radiation is initiated in the edge portion which is not drop core region and prevents nozzle is generated can be generated.

In the meantime, if the drop forming to the nozzle outlet site is very small and the uneven supply of little is comprised of the dispersion or the nozzle outlet site of the instantaneously electric field, in case the angle (θ) of the nozzle outlet is 90° less than the drop form is unable to be normal and fiber is unable to be formed and the drop let (Droplet) phenomenon can occur.

The nozzle length (L, and L.1, L2There is no meaning of being big in the electrospinning apparatus of the present invention.

As to the nozzle bore (Di), 0.01~5mm, and the nozzle external diameter (Do) desirable what is 0.01~5mm. The drop let phenomenon is right, the nozzle bore or the external diameter 0.01mm U.S. is generated. And it is impossible to fiber-forming if 5mm is exceeded.

Figs. 3 and 4 shows the nozzle which shows the nozzle in which one extension part (angle) is formed in the nozzle outlet, and in which as to figs. 5 and 6, the extension part (angle) of 2 is formed in the nozzle outlet. That is, $\theta\theta 1$ is the angle of the first nozzle outlet which is the part in which the spinning solution is radiated. 2 is the angle of the second nozzle outlet which is the part in which the spinning solution is supplied.

Nozzle (4a) within the nozzle block (4) are arranged in the Nozzle plate (4e) with multiple. And nozzle external diameter hole (4b) covering this are installed outside the nozzle (4a).

In the nozzle external diameter hole (4b) silver nozzle (4a) exit, it is installed in the purpose of collecting the spinning solution preventing the drop let (Droplet) phenomenon which is generated in case the spinning solution formed with the excess of quantity is unable to become altogether fiber and overflows. And the role of collecting the spinning solution which is unable to become fiber in the nozzle outlet and transferring this to the spinning solution temporary service pipe (4d) positioned at the Nozzle plate (4e) work upper end is played.

Diameter is rightly large than the nozzle external diameter hole (4b) silver nozzle (4a). And it is good to be comprised of insulator.

The spinning solution temporary service board (4d) play a role of transferring to the spinning solution main working board (4f) this the residual spinning solution which insulator is manufactured with insulator is provisionally stored.

The direct image shift of the spinning solution temporary service board (4d) play a role of protecting the nozzle top the insulator plate (4c) is installed and the radiation is smooth in the nozzle surrounding.

The spinning solution main working board (4f) including the electric conductor board (4h) the electric conductor board (4h) in which the Nozzle plate (4e) right below edge is identical with the nozzle arrangement is installed is installed.

Moreover, the right below edge of the spinning solution main working board (4f), the heater (4g) of the indirect heating method is installed.

The spinning solution main working board (4f) the role of applying the high voltage in the electric conductor board (4h) silver nozzle (4a) is played play a role of supplying to the nozzle (4a) after the storage the spinning solution flowed in into the spinneret block (4) into the radiation drop apparatus (3). At this time, it desirable is done by the minimum space to make so that the spinning solution main supply pipe (4f) minimize the storage quantity of the spinning solution.

In the meantime, the spinning dope drop apparatus (3) of the present invention play a role of supplying the nozzle block (4) to the drop form the spinning solution which is designed in order to have the shape of the cylindrical shape which on the whole, is shut tightly and is consecutively flowed in from the spinning dope main tank (1). Specifically the detailed content about the spinning dope drop apparatus (3) is explained in 2001-39789 A specification in which this inventor already applies for domestic patent.

Next, the method for manufacturing non-woven by using the electrospinning apparatus of the present invention is looked into.

Firstly, the thermoplastic resin or the thermosetting resin spinning dope kept within the main tank (1) is measured to the measuring pumper (2) and it supplies to the fixed quantity spinning dope drop apparatus (3).

At this time, the polyester resin, acrylic resin, phenol resin, epoxy resin, nylon resin, poly (glycolide / L-lactide) copolymers, poly resin, polyvinyl alcohol resin, PVC etc can be used as thermoplasticity or the thermosetting resin manufacturing the spinning dope. It may be acceptable that the resin melting liquid or the solution anything is used as the spinning dope.

In this way, while the spinning dope supplied within the spinning dope drop apparatus (3) passes through the spinning dope drop apparatus (3), in the above, the overcast of the spinning dope is discontinuously once blocked in other words, it is supplied to the spinning solution main working board (4f) of the nozzle block (4) in which the high voltage of the present invention hangs. It stops the flow of the spinning solution and as to the spinning dope drop apparatus (3), the role in which beginning does not flow away in the spinning solution main tank (1).

And then, in the nozzle block (4), it is the upward shooting and the spinning dope the nonwoven web is manufactured with the collector (5) of the upper part in which the voltage which is high through the bottom-up nozzle hangs.

It is discharged to the top collector (5) through the nozzle (4a) transferred to the spinning solution main supply pipe (4f) and fiber is formed. It is collected in the nozzle external diameter hole (4b) and the excessiveness spinning solution which is unable to become fiber in the nozzle (4a) again moves to the spinning solution main working board (4f) after the spinning solution temporary service board (4d).

At this time, in the electric conductor board (4h) installed at the nozzle block (4) bottom part fiber-forming by the electric force is promoted and collector (5), voltage more than 20kV is set up over 1kV generated in the voltage generating device (6) to be better. It is more advantageous in the productivity side to the collector (5) to use the endless belt. The collector (5) respects the density of non-woven to do and the constant distance is from side to side desirable to reciprocate.

In this way, if the non-woven which consecutively processes the formed nonwoven web as embossing-roller on the collector (5) and manufactured is reeled in the take up roller, the nonwoven fabric manufacture process is completed.

By using the bottom-up nozzle block (4) illustrated in before, it effectively prevents the drop let (Droplet) phenomenon and the manufacturing device of the present invention can improve the non-woven quality. Moreover, when supplying the spinning dope to the nozzle block (4) by using the spinning dope drop apparatus (3), it once makes to do with the or more cut off (drop). Therefore, the fiber forming property can be maximized.

Consequently, the fiber-forming effect by the electric force is enhanced and nanofiber and non-woven can be mass-produced. Additionally, since arranging nozzles consisting of a plurality of pins to the block type, it frees, the manufacturing method of the present invention can control width and thickness of non-woven with change.

For several uses, the nano fiber non-woven fabric that the apparatus of the present invention is manufactured with the apparatus of the present invention is used with the medical material of the artificial leather, sanitary napkin, filter, the artificial blood vessel etc, the visit to Korea vest, the semi-conductor purpose wiper, the non-woven for battery etc.

Hereinafter, more specifically, the invention is looked into through the embodiment.

Embodiment 1.

In 96% sulfuric acid solution, the relative viscosity dissolved 2.3 persons the nylon6 chip at the formic acid to 35% and the spinning dope was manufactured. While keeping the spinning dope in the main tank (1), it supplies to the spinning dope drop apparatus (3) after the measuring quantity heartburnings and the flow of the spinning

dope is discontinuously converted into the measuring pumper (2). And then, the spinning dope is supplied to the nozzle block (4) in which the voltage of 35kV hangs of fig. 2 and it radiates through nozzle to the fibrous with upturn and it accumulates on the collector (5) positioned in the top and scroll is 60cm and the nonwoven web in which the weight is 3.0g / m² is manufactured. At this time, it was 120° and the nozzle outlet angle (θ) used the nozzle in which the nozzle bore (D) was 0.9mm. The model C H 50 of the simco corp. was used as the voltage generating device. As a result of photoing the manufactured polyester nano fiber non-woven fabric with the electron microscope, as shown in Figure 8, the drop let phenomenon was not generated at all.

Embodiment 2.

After the phosphoric acid and distilled water were added in the silica gel to the drop mode, here the polyvinylalcohol solution was mixed and the silica / polyvinyl alcohol mixture which was the spinning solution was manufactured. The spinning solution was electrically radiated to the down-up type eletrospinning aparatus of the embodiment 1 under the voltage of 40kV and the silica / polyvinyl alcohol composite fiber and their non-woven in which the average diameter was 60nm were manufactured. As a result of photoing the manufactured non-woven with the electron microscope, as shown in Figure 9, the drop let phenomenon did not arise at all.

Embodiment 3.

The polyglycolic acid chip is pulverized to the freeze mill with for 30 minutes and the polyglycolic acid (PGA) powder in which the mean size is 20μm is manufactured. Next, the polyglycolic acid powder was dissolved in the hexafluoro isopropyl alcohol (HFIP) with 0.1 weight% and solution was manufactured. It let drop to slowly inside the beaker my ethanol which was solution mixed into 15,000rpm with the homogenizer. The isopropyl alcohol (HFIP) is evaporated and the colloidal suspension in which polyglycolic acid nano particles are dispersed within the ethanol is manufactured. By using the apparatus like the embodiment 1 by using this kind of colloidal suspension, it electrically radiated to the identical spinning condition and the polyglycolide nano particle in which diameter was 30nm was manufactured. The photograph taking a picture of the polyglycolide nano particle manufactured with the electron microscope is the same as that of fig. 10.

■ Effects of the Invention

It effectively prevents the drop let (Droplet) phenomenon in the electrospinning of nanofiber and the invention can do the nanofiber of the high quality with mass production.



Scope of Claims

Claim 1 :

The down-up type eletrospinning aparatus of the electrospinning apparatus consisting of the voltage generating device (6) for having voltage to the collector (5), accumulating fibers radiated from the spinning dope main tank (1), the measuring pumper (2), the nozzle block (4), to the nozzle block the nozzle block (4) and collector (5), wherein the nozzle (4a) exit installed at (i) nozzle block (4) is formed with the upper direction; (ii) collector (5) is positioned on the top of the nozzle block; and the spinning dope drop apparatus (3) is installed between (iii) spinning dope main tank (1) and nozzle block (4).

Claim 2 :

The down-up type eletrospinning aparatus of claim 1, wherein it is formed with the oviduct form more than 1 having the nozzle (4a) exit is the angle (θ) of 90~175°.

Claim 3 :

The down-up type eletrospinning aparatus of claim 1, wherein it is comprised of the heater (4g) positioned in the insulator plate (4c) installed at the Nozzle plate (4e), in which [i] nozzle (4a) of the nozzle block (4) is arranged the nozzle external diameter hole (4b), covering [ii] nozzle (4a) the spinning solution temporary service board (4d) which is positioned in the Nozzle plate (4e) direct image shift while being connected to [iii] nozzle external diameter hole (4b), and [iv] spinning solution temporary service board (4d) direct image shift, and the spinning solution main working board (4f) including the electric conductor board (4h) which the pin is arranged and positioned in the Nozzle plate (4e) right below edge identically with [v] nozzle arrangement, and [vi] electric conductor board (4e) and [vii] spinning solution main working board (4f) right below edge.



Drawings

Fig. 1

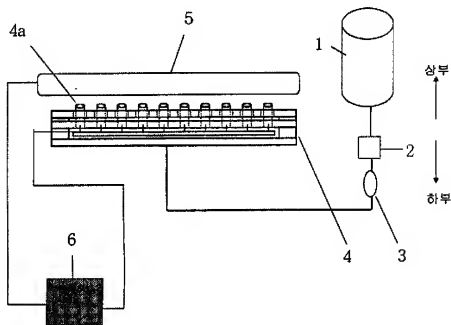


Fig. 2

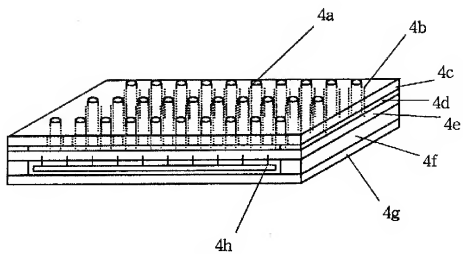


Fig. 3

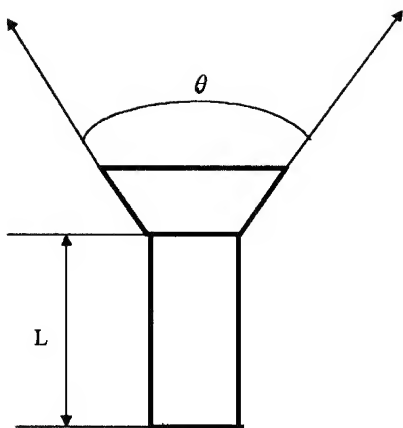


Fig. 4

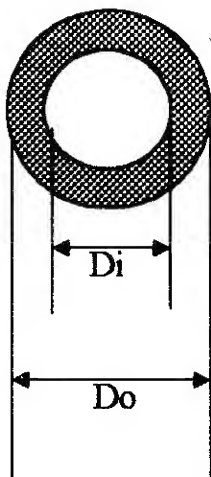


Fig. 5

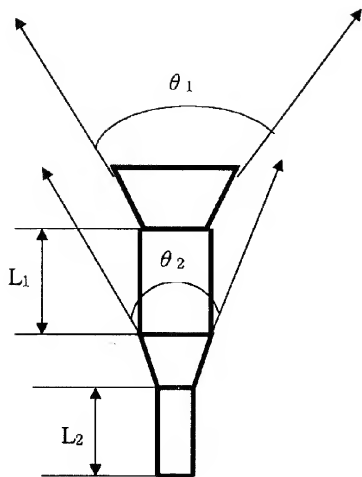


Fig. 6

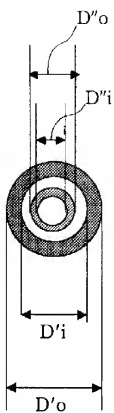


Fig. 7

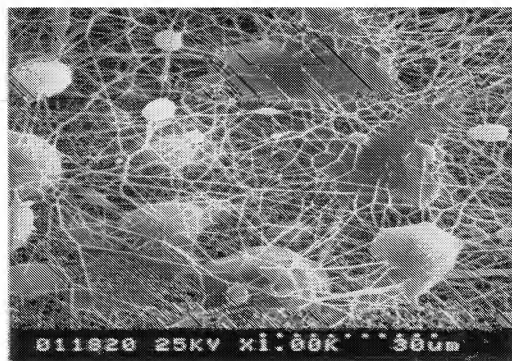


Fig. 8

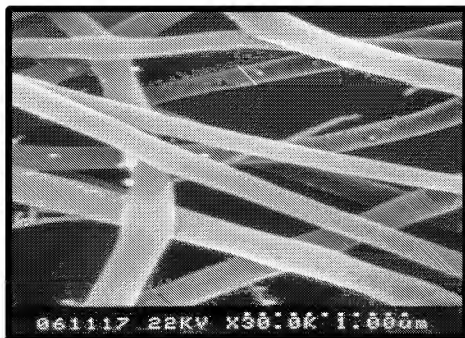


Fig. 9

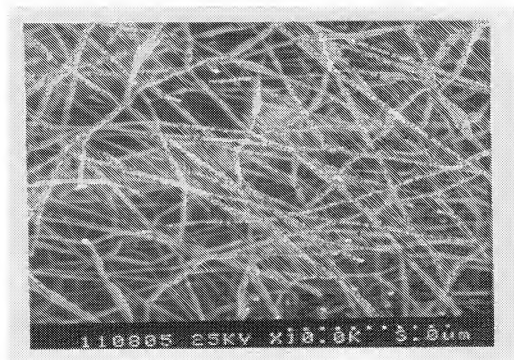


Fig. 10

